

Thermocouple temperature signal to RS-485, Modbus data acquisition module

WJ127

Product features:

- One thermocouple signal acquisition isolation conversion RS-485 output
- Using a 12 bit AD converter, the measurement accuracy is better than 0.1%
- Isolation withstand voltage between signal input/output 1000VDC
- Wide power supply range: 8~32VDC
- K/J/T/E/R/S/B/N type thermocouple input
- High reliability, easy programming, and easy application
- Standard DIN35 rail installation, convenient for centralized wiring
- Users can program module addresses, baud rates, etc
- Supports Modbus RTU communication protocol and automatic recognition protocol
- Industrial flame retardant shell, RS485 port surge protection
- Low cost, small volume modular design

Typical applications:

- Temperature signal measurement, monitoring, and control
- RS-485 remote I/O, data acquisition
- Intelligent building control, security engineering and other application systems
- RS-485 bus industrial automation control system
- Industrial site signal isolation and long-distance transmission
- Equipment operation monitoring
- Measurement of sensor signals
- Acquisition and recording of industrial field data
- Development of medical and industrial control products
- Various types of thermocouple signal acquisition

Product Overview:

The WJ127 product implements signal acquisition between sensors and hosts for detecting analog signals. The WJ27 series products can be applied to RS-485 bus industrial automation control systems, measurement of K/J/T/E/R/S/B/N thermocouple signals, as well as industrial field signal isolation and long-distance transmission.

The product includes power isolation, signal isolation, linearization, A/D conversion, and RS-485 serial communication. Each serial port can connect up to 255 WJ25 series modules, and the communication method adopts ASCII code communication protocol or MODBUS RTU communication protocol. The address and baud rate can be set by code, and can be hung on the same RS-485 bus with control modules from other manufacturers for easy computer programming.



diagram 1 WJ127 module appearance diagram

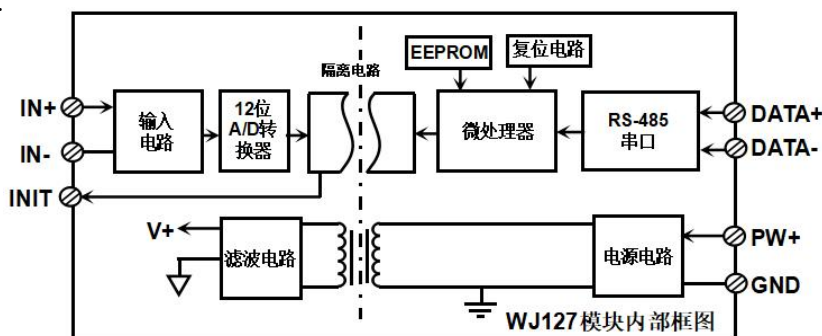


Figure 2 Internal Block Diagram of WJ127 Module

The WJ127 series products are intelligent monitoring and control systems based on microcontrollers. All user set calibration values, addresses, baud rates, data formats, parity checks, and other configuration information are stored in non-volatile memory EEPROM.

The WJ127 series products are designed and manufactured according to industrial standards, with isolation between signal inputs/outputs. They can withstand 1000VDC isolation voltage, have strong anti-interference ability, and high reliability. The working temperature range is -45 °C to +85 °C.

Function Introduction:

The WJ127 signal isolation acquisition module can be used to measure one temperature signal.

1、 Temperature signal input

12 bit acquisition accuracy, 1 thermocouple temperature signal input. All signal input ranges have been calibrated before the product leaves the factory. During use, users can also easily program and calibrate themselves.

2、 Communication Protocol

Communication interface: 1 standard RS-485 communication interface.

Communication Protocol: Supports two protocols, the character protocol defined by the command set and the MODBUS RTU communication protocol. The module automatically recognizes communication protocols and can achieve network communication with various brands of PLCs, RTUs, or computer monitoring systems.

Data format: 10 digits. 1 start bit, 8 data bits, 1 stop bit, no checksum.

The communication address (0-255) and baud rate (2400, 4800, 9600, 19200, 38400, 57600, 115200bps) can be set;

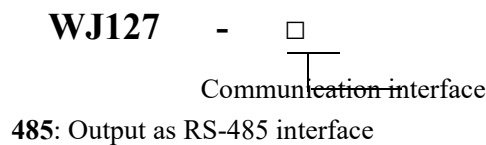
The communication network can reach a maximum distance of 1200 meters and is connected through twisted pair shielded cables.

High anti-interference design of communication interface, ± 15KV ESD protection, communication response time less than 100mS.

3、 anti-interference

Parity check can be set as needed. There is a transient suppression diode inside the module, which can effectively suppress various surge pulses, protect the module, and the internal digital filter can also effectively suppress power frequency interference from the power grid.

Product selection:



Selection example 1: Model: **WJ127-485** represents thermocouple signal input, and the output is RS-485 interface

WJ127 General Parameters:

(Typical @+25 °C, Vs is 24VDC)

Input type: thermocouple signal input, supports multiple thermocouple signals, K/J/T/E/R/S/B/N type thermocouples

Accuracy: 0.1% (excluding cold end sensor error)

Temperature drift: ± 50 ppm/°C (± 100 ppm/°C, maximum)

Input resistance: greater than 1M Ω

Cold end compensation sensor accuracy: ± 0.5 °C

Bandwidth: -3 dB 10 Hz

Conversion rate: 10 Sps (factory default value, users can modify the conversion rate by issuing commands.)

You can set the AD conversion rate to 2.5 SPS, 5 SPS, 10 SPS, and 20 SPS by sending commands. (Channel conversion rate=AD conversion rate/number of open channels)

Note: Please recalibrate the module after modifying the conversion rate, otherwise the measured data may have deviations. You can also specify the conversion rate when placing an order, and we will recalibrate the product according to the conversion rate you require when it leaves the factory.

Common mode rejection (CMR): 120 dB (1k Ω Source Imbalance @ 50/60 Hz)

Normal mode suppression (NMR): 60 dB (1k Ω Source Imbalance @ 50/60 Hz)

Input protection: overvoltage protection, overcurrent protection

Communication: RS-485 standard character protocol and MODBUS RTU communication protocol

Baud rates (2400, 4800, 9600, 19200, 38400, 57600, 115200bps) can be selected by software

The address (0-255) can be selected by software

Communication response time: 100 ms maximum

Working power supply: +8~32VDC wide power supply range, with internal anti reverse and overvoltage protection circuits

Power consumption: less than 1W

Working temperature: -45~+80 °C

Working humidity: 10~90% (no condensation)

Storage temperature: -45~+80 °C

Storage humidity: 10~95% (no condensation)

Isolation withstand voltage: 1KVDC between input/output, 1 minute, leakage current 1mA

The RS-485 output and power supply are grounded together.

Surge resistant voltage: 1KVAC, 1.2/50us (peak value)

Dimensions: 106 mm x 59mm x 24mm

Pin definition:

Pin	name	Description	Pin	name	Description
one	PW+	Positive end of power supply	five	INIT	Initial state setting
two	GND	Negative end of power supply			
three	DATA+	RS-485 signal positive terminal	six	IN-	Negative input terminal of thermocouple
four	DATA-	RS-485 signal negative terminal	seven	IN+	Positive input terminal of thermocouple

Table 1 Pin Definition

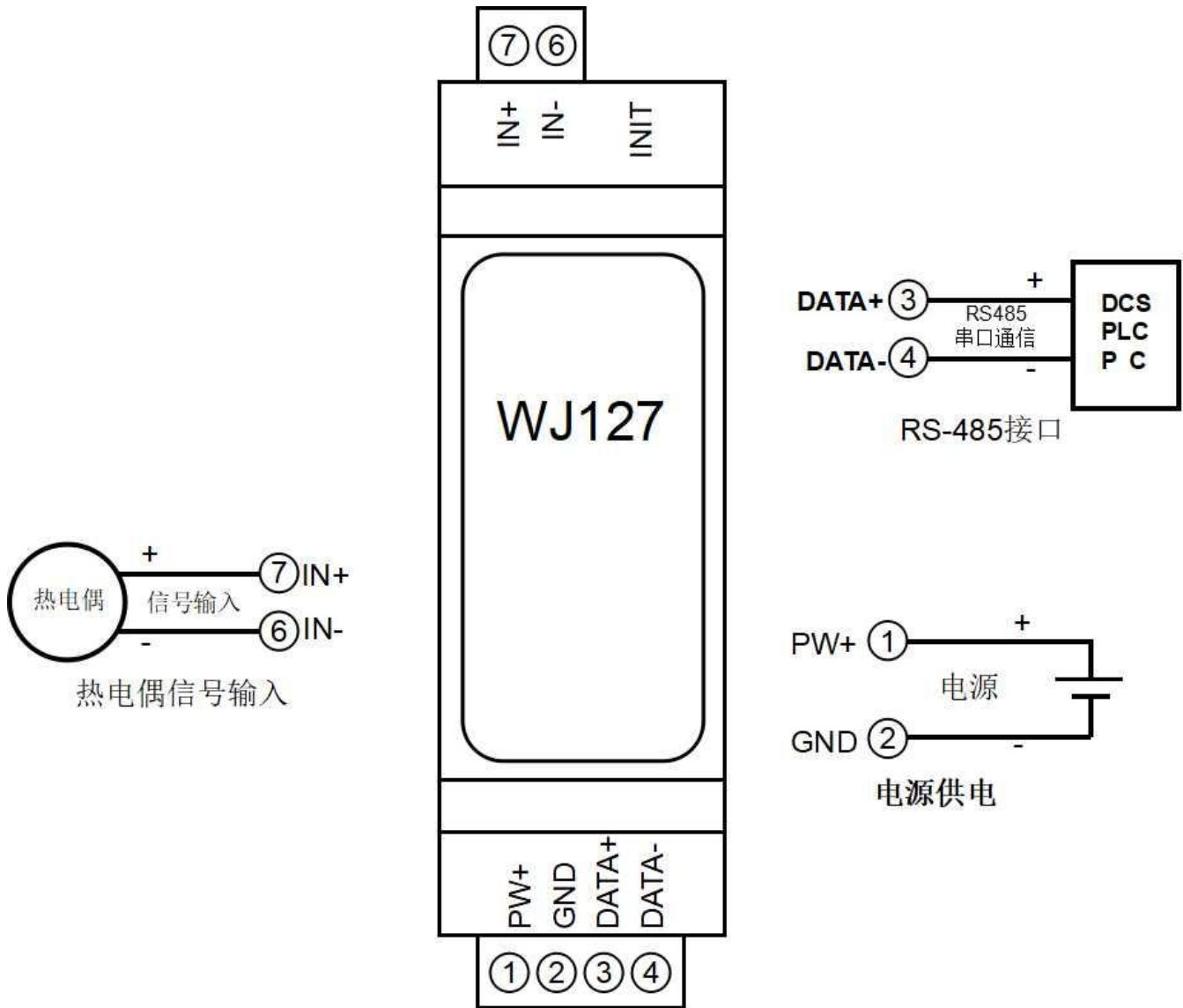


Figure 3 Wiring diagram of WJ127 module

WJ127 Character Protocol Command Set:

The factory initial settings of the module are shown below. If the parameters are forgotten, press and hold the Initiat switch for 2 seconds while powered on, and then release it, the module can also be restored to its factory settings.

Address 01

Baud rate 9600 bps

No parity check

1. Read analog input module data command

Explanation: Read back the temperature data of the thermistor from the module, which is the actual temperature value.

If the data is+8888.8, it indicates a thermocouple break.

Command format: # 01

Parameter description: # delimiter.

01 module address, with a value range of 00 to FF (hexadecimal). The factory address is 01, which is converted to hexadecimal as the ASCII code for each character. If address 01 is replaced with hexadecimal, it will be 30H and 31H.

Response format: The **>(data) (cr)** command is valid.

? The **AA (cr)** command is invalid or an illegal operation or channel is closed.

Parameter description: >delimiter.

(data) represents the retrieved data. The data format is temperature values.

(cr) End symbol, enter key on the upper computer (ODH).

Other instructions: If there is a syntax error, communication error, or if the address does not exist, the module will not respond.

Application example: User command (character format) **# 01**

(Hexadecimal format) **233031**

Module response (character format) **>+0180.0 (cr)**

(Hexadecimal format): **3E2B303138302E300D**

Explanation: The input on address 01H module is: +0180.0 °C

2、Set thermocouple input type command

Description: Set the thermocouple input type. K/J/T/E/R/S/B/N type thermocouple, choose according to the actual thermocouple connected.

Command format: **\$01TXX**

Parameter description: \$delimiter.

01 module address, with a value range of 00 to FF (hexadecimal). Factory address is 01, converted to hexadecimal as ASCII for each character

The code. If address 01 is replaced with hexadecimal, it will be 30H and 31H.

T thermocouple type.

XX uses hexadecimal to represent type encoding. Indicate the type of thermocouple being measured (default is 00, K-type thermocouple). Please refer to Table 1.

Module model	Type code (TT)	Input Range
WJ127	00	Type K thermocouple, -270°C~1300°C
	01	Type J thermocouple, -200°C~1200°C
	02	Type T thermocouple, -270°C~400°C
	03	Type E thermocouple, -270°C~1000°C
	04	Type R thermocouple, -50°C~1750°C
	05	Type S thermocouple, -50°C~1750°C
	06	Type B thermocouple, 250°C~1800°C
	07	Type N thermocouple, -200°C~1300°C

Table 1 Thermocouple Type Codes

Response format: ! The **01 (cr)** command is valid.

? The **01 (cr)** command is invalid or an illegal operation.

Application example: User command **\$01T00**

Module response: **! 01 (cr)**

Explanation: Set the thermocouple input type to K type

3、Read thermocouple input type command

Description: Read the input type of thermocouple.

Command format: **\$01R**

Parameter description: \$delimiter.

01 module address, with a value range of 00 to FF (hexadecimal). The factory address is 01.

R reads the thermocouple type.

Response format:!
The **01XX (cr)** command is valid, where XX represents the type of thermocouple. Please refer to Table 1 for thermocouple type codes.

? The **01 (cr)** command is invalid or an illegal operation.

Application example: User command **\$01R**

Module response!
0100 (cr)

Explanation: 00 indicates that the thermocouple input type is K-type

4. Configure WJ127 module command

Explanation: Set the address, input range, baud rate, and parity for a WJ127 module. The configuration information is stored in non-volatile memory EEPROM.

Command format: **% AANNTTCCFF**

Parameter description: % delimiter.

AA module address, with a value range of 00 to FF (hexadecimal). The factory address is 01, which is converted to hexadecimal as the ASCII code for each character. If address 01 is replaced with hexadecimal, it will be 30H and 31H.

NN represents the new module hexadecimal address, with values ranging from 00 to FF. Convert to hexadecimal to ASCII code for each character. If address 18 is replaced with hexadecimal as 31H and 38H.

TT uses hexadecimal to represent type encoding. The WJ127 product must be set to 00.

CC uses hexadecimal to represent baud rate encoding.

Baud rate code	Baud rate
04	2400 baud
05	4800 baud
06	9600 baud
07	19200 baud
08	38400 baud
09	57600 baud

Table 2 Baud rate codes

FF uses 8 bits in hexadecimal to represent parity check.

00: No verification

10: Odd verification

20: Even verification

Response format:!
The **AA (cr)** command is valid.

? The **AA (cr)** command is invalid or an illegal operation.

Parameter description:!
The delimiter indicates that the command is valid.

? The delimiter indicates that the command is invalid.

AA represents the input module address

(cr) End symbol, upper computer enter key, hexadecimal is 0DH.

Other instructions: If you are configuring the module for the first time, AA=01H, NN equals the new address.

If the format is incorrect, the communication is incorrect, or the address does not exist, the module will not respond.

Application example: User command% **0111000600**

Module response! **11(cr)**

Explanation:% delimiter.

01 means that the original address of the WJ127 module you want to configure is 01H.

11 indicates that the new module's hexadecimal address is 11H, please note that the new address is 0x11 in hexadecimal.

The **00** WJ127 product must be set to 00.

06 represents a baud rate of 9600 baud.

00 indicates no verification.

5. Read configuration status command

Explanation: Read configuration for a designated WJ127 module.

Command format: **\$012**

Parameter description: \$delimiter.

01 module address, with a value range of 00 to FF (hexadecimal).

2 represents the command to read the configuration status

(cr) End symbol, upper computer enter key, hexadecimal is 0DH.

Response format:! The **AATTCFF (cr)** command is valid.

? The **AA (cr)** command is invalid or an illegal operation.

Parameter description:! Boundary symbol.

AA represents the input module address.

TT stands for type code.

CC stands for baud rate encoding. The WJ127 product must be 00.

FF is shown in Table 3

(cr) End symbol, upper computer enter key, hexadecimal is 0DH.

Other instructions: If the format is incorrect, the communication is incorrect, or the address does not exist, the module will not respond.

Application example: User command **\$012**

Module response! **01000600(cr)**

Explanation:! Boundary symbol.

01 indicates that the WJ127 module address is 01H.

00 indicates that the input is a K-type thermocouple.

06 represents a baud rate of 9600 baud.

00 indicates no verification.

6. Set module AD conversion rate

Description: Set the AD conversion rate of the module. Among them, channel conversion rate=AD conversion rate/number of opened channels. The slower the sampling rate, the more accurate the data collected. Users can adjust it according to their needs. The default conversion rate at the factory is 10SPS.

Note: Please recalibrate the module after modifying the conversion rate, otherwise the measured data may have deviations. You can also specify the conversion rate when placing an order, and we will recalibrate the product according to the conversion rate you require when it leaves the factory.

Command format: **\$AA3R**

Parameter description: \$delimiter.

AA module address, with a value range of 00 to FF (hexadecimal).

3 represents the command to set conversion rate

R conversion rate code, which can range from 0 to 3

Code R	0	one	two	three						
Conversion rate	2.5 SPS	5 SPS	10 SPS	20 SPS						

Response format: **!** The **AA (cr)** command is valid.

? Invalid or illegal operation of **AA (cr)** command

Parameter description: **!** The delimiter indicates that the command is valid.

? The delimiter indicates that the command is invalid.

AA represents the input module address.

(cr) End symbol, upper computer enter key, hexadecimal is 0DH.

Other instructions: If the format is incorrect, the communication is incorrect, or the address does not exist, the module will not respond.

Application example 1: User command **\$0132**

Module response: **! 01 (cr)**

Explanation: Set the AD conversion rate to 10SPS.

Application example 2: User command **\$0133**

Module response: **! 01 (cr)**

Explanation: Set the AD conversion rate to 20SPS.

7. Read module AD conversion rate

Explanation: Read the AD conversion rate of the module. Among them, channel conversion rate=AD conversion rate/number of opened channels. The slower the sampling rate, the more accurate the data collected.

Command format: **\$AA4**

Parameter description: \$delimiter.

AA module address, with a value range of 00 to FF (hexadecimal).

4 represents the read conversion rate command

Response syntax: **!** The **AAR (cr)** command is valid.

? Invalid or illegal operation of **AA (cr)** command

Parameter description: **!** The delimiter indicates that the command is valid.

? The delimiter indicates that the command is invalid.

AA represents the input module address.

R conversion rate code, which can range from 0 to 3

Code R	0	one	two	three						
Conversion rate	2.5 SPS	5 SPS	10 SPS	20 SPS						

(cr) End symbol, enter key on the upper computer (0DH).

Other instructions: If there is a syntax error, communication error, or if the address does not exist, the module will not respond.

Application example 1: User command **\$014**

Module response: **! 012 (cr)**

Explanation: The current AD conversion rate is 10SPS.

Application example 2: User command **\$014**

Module response! **013 (cr)**

Explanation: The current AD conversion rate is 20SPS.

8. Read CJC cold end compensation temperature command

Explanation: Read the value of the CJC cold end compensation temperature sensor and return the value in °C.

Command syntax: **\$AA5 (cr)**

Parameter description: \$delimiter.

AA module address, with a value range of 00 to FF (hexadecimal).

5 Read CJC temperature value command.

Response syntax: The **>(data) (cr)** command is valid.

? The **AA (cr)** command is invalid or an illegal operation, or the input is not configured as a thermocouple signal input.

Parameter description: >delimiter, indicating that the command is valid.

? The delimiter indicates that the command is invalid.

(data) represents the numerical value of the CJC sensor, measured in °C. Format composition: One "+" or "-" symbol, followed by five decimal digits and one decimal point. The decimal point is fixed and the resolution is 0.1 °C.

AA represents the input module address

(cr) End symbol, enter key on the upper computer (ODH).

Other instructions: If there is a syntax error, communication error, or if the address does not exist, the module will not respond.

Application example: User command **\$015**

Module response **>+0024.9 (cr)**

Explanation: The temperature of the CJC sensor on module 01H is 24.9 °C.

9. CJC Cold End Compensation Offset Calibration Command

Explanation: CJC cold end compensation offset calibration can be used to calibrate the error of cold end temperature.

Command syntax: **\$AA6 (Counts)**

Parameter description: \$delimiter.

AA module address, with a value range of 00 to FF (hexadecimal).

6 represents CJC (Cold End Compensation) offset calibration command

The size of the CJC offset value (**Counts**) is set to +000.0 by factory default. The command consists of 4 characters and one decimal point, with a + or - symbol, and ranges from 000.0 to 999.9. Represents 0 to 999.9 °C.

For example: +001.5 means an increase of 1.5 °C

-010.0 means a decrease of 10 °C

Response syntax: ! The **AA (cr)** command is valid.

? The **AA (cr)** command is invalid or an illegal operation, or the input is not configured as a thermocouple signal input.

Parameter description: ! The delimiter indicates that the command is valid.

? The delimiter indicates that the command is invalid.

AA represents the input module address.

(cr) End symbol, enter key on the upper computer (ODH).

Other instructions: If there is a syntax error, communication error, or if the address does not exist, the module will not respond.

Application example: User command **\$016+001.0**

Module response! **01(cr)**

Explanation: The temperature of the CJC sensor increases by 1 degree.

10. Read CJC cold end compensation offset calibration command

Explanation: Read the CJC cold end compensation temperature offset calibration value.

Command syntax: **\$AA7**

Parameter description: **\$delimiter**.

AA module address, with a value range of 00 to FF (hexadecimal).

7 represents the command to read the CJC cold end compensation temperature offset calibration value.

Response syntax: **!** The **AA (Counts) (cr)** command is valid.

? The **AA (cr)** command is invalid or an illegal operation.

Parameter description: **!** The delimiter indicates that the command is valid.

? The delimiter indicates that the command is invalid.

AA represents the input module address.

(Counts) Read the value of CJC offset size.

(cr) End symbol, enter key on the upper computer (ODH).

Other instructions: If there is a syntax error, communication error, or if the address does not exist, the module will not respond.

Application example: User command **\$017**

Module response: **! 01+001.0(cr)**

Explanation: The temperature of the CJC sensor increases by 1 degree.

11. Reset all parameters set by the above character command to factory settings.

Explanation: The parameters set by the module using the above character commands are restored to factory settings.

Command format: **\$AA900** Set parameters to factory settings.

Parameter description: **AA** module address, value range 00~FF (hexadecimal). The factory address is 01, which is converted to hexadecimal as the ASCII code for each character. If address 01 is replaced with hexadecimal, it will be 30H and 31H.

Response format: **! AA (cr)** indicates successful setup, and the module will automatically restart.

Application example: User command (character format) **\$01900**

Module response (character format): **! 01(cr)**

Explanation: Parameters are reset to factory settings.

Modbus RTU communication protocol:

The factory initial settings of the module are shown below. If the parameters are forgotten, press and hold the Initiat switch for 2 seconds while powered on, and then release it, the module can also be restored to its factory settings.

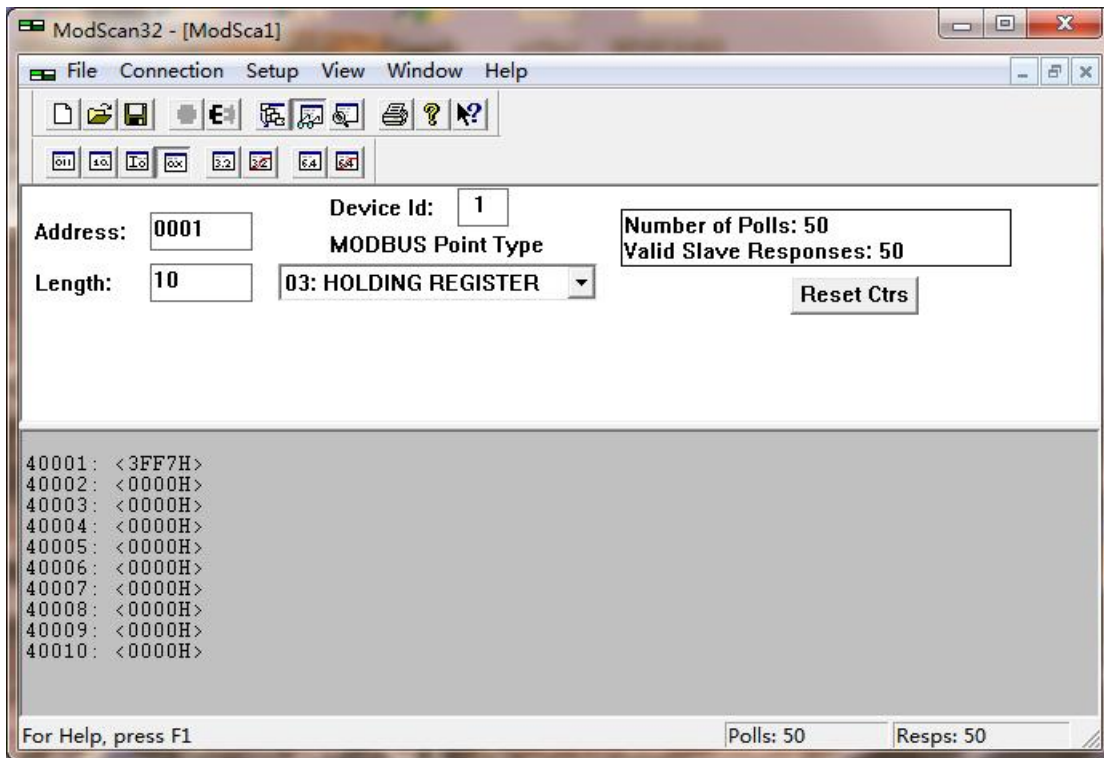
Address 01

Baud rate 9600 bps

No parity check

Supports Modbus RTU communication protocol **function codes 03** (read hold register), **06** (write single register), and **16** (write multiple registers), with command formats following the standard Modbus RTU communication protocol.

Modbus software testing example:



The registers supporting function codes 03 and 06 are as follows:

Address (PLC)	4X	Address (PC, DCS)	Data content	attribute	Data Explanation
forty thousand and one		0	Integer temperature value	read-only	The measured temperature data, signed integer, divided by 10 equals the actual temperature. If the data is 8888, it indicates that the thermocouple is disconnected.
forty thousand and two		one	CJC sensor temperature	read-only	The temperature value of the cold end sensor, a signed integer, divided by 10 equals the actual temperature.
forty thousand and three		two	CJC sensor temperature offset modification value	Read/Write	Signed integer, divided by 10 equals the actual modified temperature. Used to modify the error of the cold end temperature. The default value is 0, and changing it to 10 indicates an increase of 1 degree in the cold end temperature.
forty thousand and four		three	Thermocouple type code	Read/Write	0~7 represents the type of thermocouple input, Specific selection can refer to Table 1
40005~40006		4~5	Floating point temperature value	read-only	The measured temperature data is a 32-bit floating-point number, and the data format is CDAB, which means: The lower 16 bits are in register 40005, The high 16 bits are in register 40006

				If the data is 8888.8, it indicates that the thermocouple is disconnected.
forty thousand and two hundred	one hundred and ninety-nine	Parameter reset to factory settings	Read/Write	If set to FF00, all register parameters of the module will be restored to factory settings, and the module will automatically restart after completion
forty thousand two hundred and one	two hundred	Module address	Read/Write	Integer, effective after restart, range 0x0000-0x00FF
forty thousand two hundred and two	two hundred and one	Baud rate	Read/Write	Integer, effective after restart, range 0x0004-0x000A 0x0004 = 2400 bps, 0x0005 = 4800 bps 0x0006 = 9600 bps, 0x0007 = 19200 bps 0x0008 = 38400 bps, 0x0009 = 57600 bps 0x000A = 115200bps
forty thousand two hundred and three	two hundred and two	Parity check	Read/Write	Integer, takes effect after restart 0: No verification 1: Odd verification 2: Even verification
forty thousand two hundred and four	two hundred and three	Conversion rate	Read/Write	Integer, range 0x0000-0x0003, The factory default is 2. Please recalibrate the module after modification. 0x0000 = 2.5 SPS, 0x0001 = 5 SPS, 0x0002 = 10 SPS, 0x0003 = 20 SPS

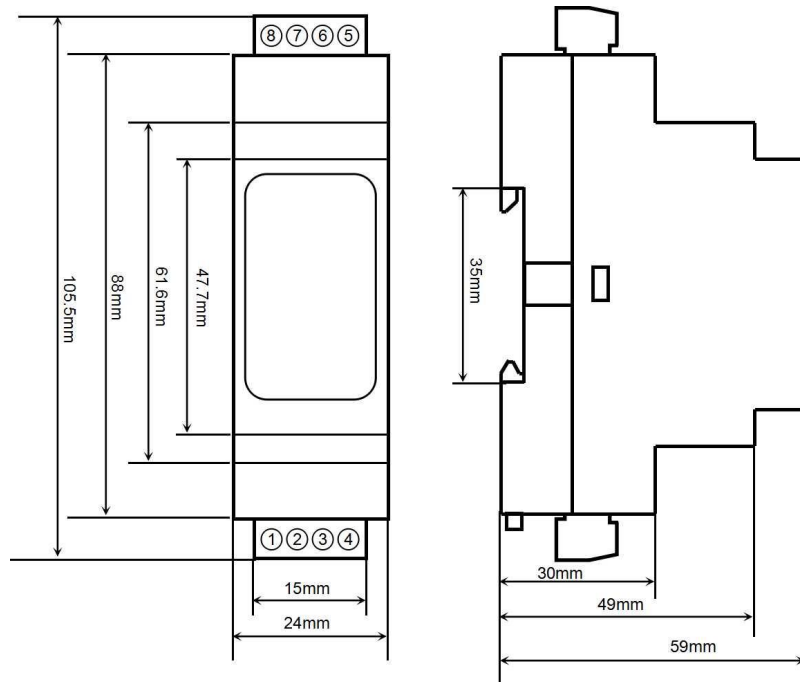
Communication example: If the module address is 01, send **01030000001840A** in hexadecimal to retrieve the data from register 40001.

01	03	00	00	00	01	eighty-four	0A
Module address	Read and hold register	Register Address High Bit	Low bit register address	Register quantity high	Low register quantity	CRC check low bit	CRC check high bit

If the module replies: **0103020BB8BF06**, the read data is 0x0BB8, converted to decimal 3000, and then divided by 10, it indicates that the current input temperature is 300.0 °C.

01	03	02	nineteen	ninety-nine	BF	06
Module address	Read and hold register	The number of bytes in the data	data-high	data-low	CRC check low bit	CRC check high bit

Dimensions: (Unit: mm)



Can be installed on standard DIN35 rails

guarantee:

Within two years from the date of sale, if the user complies with the storage, transportation, and usage requirements and the product quality is lower than the technical specifications, it can be returned to the factory for free repair. If damage is caused due to violation of operating regulations and requirements, device fees and maintenance fees shall be paid.

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